

02.01-1/11/02-2952



UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

REGION 4  
SAM NUNN ATLANTA FEDERAL CENTER  
61 FORSYTH STREET, S.W.  
ATLANTA, GEORGIA 30303

January 11, 2002

4WD-FFB

CERTIFIED MAIL  
RETURN RECEIPT REQUESTED

Mr. Kirk Stevens  
Department of the Navy - Atlantic Division  
Naval Facilities Engineering Command  
Code 1823  
Norfolk, Virginia 23511-6287

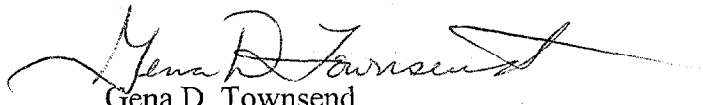
SUBJ: MCB Camp Lejeune  
Engineering Evaluation/Cost Analysis  
Operable Unit No. 16 - Site 89

Dear Mr. Stevens:

The Environmental Protection Agency (EPA) has completed its review of the above subject document, dated October 2001. Comments are enclosed.

If there are any questions, I can be reached at (404) 562-8538.

Sincerely,

  
Gena D. Townsend  
Senior Project Manager

cc: Dave Lown, NCDEHNR  
Rick Raines, MCB Camp Lejeune

**United States Environmental Protection Agency (EPA)**  
**Comments on the for Engineering Evaluation/Cost Analysis (EE/CA)**  
**Operable Unit No. 16, Site 89**  
**Marine Corps Base, Camp Lejeune, North Carolina**  
**Dated October 2001**

**OVERALL TECHNICAL COMMENTS**

Remediation of DNAPL in areas of mixed fine-grained and coarse-grained sediments has traditionally posed considerable technical challenges. Electrical Resistance Heating (ERH) does appear to have a technical advantage over the other technologies presented because, as stated in the document, it is the only technology not dependent upon fluid flow. The EE/CA guidance requires that other factors be compared and ranked but ultimately, one should pick the technology that has the best technical chance of success, all other factors being equal. The EPA does agree with the selection of the ERH for the remedial alternative for these sites. However, General and Specific Comments discuss some inaccuracies and some overly optimistic statements, which should be addressed prior to this project going forward.

**GENERAL COMMENTS**

1. In evaluating the effectiveness of the four treatments, the only criterion that appears to result in significant differences among the Options is 'Overall Protection of Human Health and the Environment'. However, if the details are examined, it is not clear that there is an obviously better alternative and there are several conflicting lines of evidence. For example on Page 4-6 the potential for mobilization of DNAPLs downward into the aquifer due to decreased viscosity is cited as an implementation concern for Option 1 (Steam Stripping). On the same page in the Option 2 - Electrical Resistive Heating (EHR) section, the decreased viscosity of the DNAPL is said to "improve mobility", implying a benefit derived from the decreased viscosity. On Page 4-6 the use of the "hot floor remediation"(heating from below the contamination) is cited as a limitation for Option 1- Steam Injection and yet on Page 4-7 "hot floor remediation" is cited as advantage for Option 2 - EHR. All four options share aspects of the same technologies. It is common in the industry that many remedial approaches are variations of the same basic technology. However, one factor affecting similar technologies cannot be an advantage in one technology and a disadvantage in another, when applied at the same site.

The concern for vertical fracturing is raised for both the Option 1- Steam Injection and Option 4 - VER/Pneumatic Fracturing/Oxidation. Clearly, one would not want to drive

contamination into drinking water aquifers. In Option 1, the steam would be injected below the contamination, expecting the heated fluids to rise aided by sufficient vacuum extraction. It is unclear where, as the text asserts, the high probability of downward migration exists. In Option 4, the subsurface would be pneumatically fractured allowing for the emplacement of oxidizing agents. Presumably, the pneumatic fracturing would create horizontal and vertical fractures with the vertical fractures propagating and driving contamination downward into previously uncontaminated aquifers. This would be a valid concern for the Agency. In fact, this very issue was raised with CH2M Hill in regards to the chosen technology for the Phase II Corrective Measures Study Work Plan for SWMU 70, Zone E at the Charleston Naval Complex. This document proposed to use pneumatic fracturing to aid the emplacement of a reducing agent to reduce the toxicity of hexavalent chromium contamination. During repeated inquiries, the Agency was told that the fracturing would be along bedding planes and not expected to go in a vertical direction. Both sites are in a lower coastal plain setting with heterogeneous sediments. Both sites are being managed by CH2M Hill presumably using the same technology vendor. It is unclear how a technology that is portrayed as unfavorable at one site could possibly be recommended as being without significant risk at another similar site.

In summary, the EE/CA's evaluation of the effectiveness of the various options as to their overall protection of human health and the environment appears to cite certain evidence as an advantage for some options while citing the same evidence as a disadvantage for another. The reality of the situation may be that there is no option which is clearly more effective than any other option in this setting.

2. As to implementability, three of the four criteria (as per Table 5-3, Summary of Alternative Comparison) appear to be nearly identical with minor logistical and materials differences for Options 2 and 3. The only significant differences noted are in the technical feasibility criterion. Options 1 and 3 both have technical restraints in that subsurface conditions "limit subsurface steam flow" while Options 2 and 4 do not appear to have technical restraints, as per Table 5-3. However, on Page 4-3, it is noted that "the first three options are *extraction* technologies, which employ mass transfer from the liquid to the vapor phase as the primary vehicle for contaminant removal." On Page 4-6, a portion of the description for Option 2 includes the statement that "Steam, laden with DNAPL vapor, is withdrawn by SVE (*soil vapor extraction*) and treated above ground." Further, on Page 5-4, it is stated that "the primary concern with all four options presented is SVE vapor extraction." Since the same subsurface site conditions (heterogeneous sediments) apply to all the options and all four require SVE, it is unclear how Options 2 and 4 have "no technical restraints." It would appear that all four technologies are nearly equally disadvantaged by the site conditions and the need for SVE.

3. In evaluating cost, all Options fall within a  $\pm \$500,000$  range ( $\pm 20\%$ ) for the total cost. Upon reviewing the detailed cost estimates provided in Appendix A, one may see that there is considerable financial uncertainty built into these first three estimates. The estimates included in Appendix A are an aggregate of contractors' bids, engineers estimate, profit and G&A, and contingency. The only firm numbers appear to be the contractor's bids. The remaining numbers all have varying degrees of uncertainty. If one totals the items listed as an engineer's estimate and the 30% contingency built into each scenario, that amount is approximately 35% of the total cost of that option. That is to say that the uncertainty of the cost within each scenario exceeds the variability among the scenarios, effectively removing cost as a deciding factor. If one compares the present worth costs presented in Table 5-2, the 30% contingency alone is enough to make the costs for all four scenarios approximately equivalent. The relative ranking cost factors shown in Table 6-1 show rankings that have considerable uncertainty built in so that cost should not be the deciding factor in the selection of a technology.

Additionally, the Dynamic Underground Stripping (DUS) and Steam Injection are both expected to include a pilot test to assure implementability and effectiveness. While on the other hand, ERH is not expected to include a pilot test, not because it is demonstrably more effective or easier to implement, but rather because mobilization costs for a pilot test are too high. All Options should be considered on an equal basis and significant factors such as the need for a pilot test should not be dismissed simply because they are expensive. That is exactly the point of the comparison. If a pilot test is desirable for ERH for technical considerations, then the cost of that pilot test should be included in the evaluation.

4. All planimetric maps of the site should contain a North arrow. Please include this on all appropriate figures in the subsequent version of this report.

#### SPECIFIC COMMENTS

1. **Page 2-5, Section 2.1.4.** The first paragraph discusses hydraulic head differences in the area and specifically references wells north of Edwards Creek. As Edwards Creek is depicted as a north/south oriented feature, it is unclear which wells are considered north of Edwards Creek. The paragraph further discusses a downward hydraulic gradient. In reviewing the two potentiometric surface maps, Figures 2-4 and 2-5 (shallow and intermediate potentiometric maps, respectively) have contours that actually overlap only at location MW16/MW16IW. At that location, there is an upward gradient, although the date of the water level measurements is unclear. Please revise the figures to include water level values set to a specified datum, posted adjacent to the appropriate well and

have the water levels be from one concurrent water level sampling event. Given the considerable fluctuation of the rainfall in recent years, combining water levels from different seasons, much less different years, does not provide accurate information upon which to evaluate the potential for downward migration of contaminated waters. Once these maps are revised, please reevaluate the hydraulic gradients in this immediate area and revise the text as appropriate.

2. **Page 4-7 Section 4.2.** The third bullet discusses contaminants being "boiled off". It is unclear as to the meaning of the phrase. One could assume that the temperature is raised and the contamination, having a lower vapor pressure than water, would transfer to the vapor state and be removed by the SVE system. Please rewrite this section to provide more technical clarity.
3. **Page 5-2, Section 5.1.1.** The first paragraph needs to include text which discusses the destruction of dissolved phase contaminants by in-situ hydrous pyrolysis oxidation as discussed in Option 1, Section 4.1. This process probably also occurs with Option 3, Section 4.3, although it is not specifically mentioned.
4. **Page 5-4, Section 5.1.4.** The second sentence states that the "treatment options are designed to reduce the... mobility... of DNAPL...". This appears to be contrary to the previous discussions, especially for Options 1, 2 and 3 which were described as extraction technologies. One would assume that the increased mobility of the DNAPL would be required to make these technologies effective. Please revise as necessary.
5. **Page 5-4, Section 5.1.5.** The estimates of 90% to 99% removal efficiencies seem optimistic. The referenced document (ITRC Technology Overview, 2000) does give such glowing success studies. However, success with electrical resistive heating at Cape Canaveral AFB has been more elusive. The Sixth Interim Report for the DNAPL remediation demonstration project (document available at [http://www.getf.org/newvpn/filelibrary/general\\_view.cfm](http://www.getf.org/newvpn/filelibrary/general_view.cfm)) indicates that 50% of the DNAPL mass was removed during the demonstration. The DNAPL reduction for the Middle Fine Grained Unit was 17.4%. Included in that report is a brief mention of back to back hurricanes which deposited 30 inches of rain on the site, filling the vadose zone and probably allowing TCE to flow uncontrolled along on the surface. The Marine Corps, the Regulators and the Consultants should not always believe the rosy predictions of near perfect success offered by selected project summaries.
6. **Page 5-4, Section 5.2.1.** It is unclear as to the concerns expressed in the second paragraph regarding shallow depth of injection. Figure 2-7 shows source material as deep as 35 feet below land surface. In order to treat the material at this depth, it is assumed

that the injection would be at this approximate depth with the steam rising aided by a SVE system. Please provide clarification to this section.

7. **Page 6-3, Section 6.4.** In the second paragraph of the recommendations the text states that "ERH is very dependable, so a pilot test is not recommended". Please review the series of reports contained on the web site listed in Specific Comment No. 5, take special note of the three technologies' effectiveness and implementation problems and revise this recommendation as necessary.